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ABSTRACT

Previous research in California, Alaska, and West Virginia has suggested that school or school district size may influence student achievement indirectly by mediating the effects of socioeconomic status (SES) on achievement. The Matthew Project is replicating the key analyses of the West Virginia study in four strategically chosen states: Georgia, Ohio, Montana, and Texas. This paper summarizes preliminary results related to school district size in Ohio and Montana. Variables included grade-level measures of achievement from statewide data sets for 1996-97; various proxies for SES (Aid to Dependent Children in Ohio and free and reduced-price meal rate in Montana); and school district size (actual size in Ohio and district enrollment in the grade under analysis in Montana, which has various district configurations). In each state, school districts were divided into two groups at the median for size. Preliminary findings include descriptive statistics, district-level regression equations for the ninth grade in Ohio and the eighth grade in Montana, effect sizes as appropriate, and correlational analysis by district size halves. Ohio results indicate an overall interaction pattern in which lower poverty rates were associated with greater benefits from large district size. Smaller Ohio districts exhibited a weaker correlation between district-level SES and aggregate student achievement at the ninth-grade level. In Montana, the interaction effect was weak, but unexpectedly, district size had a direct negative effect on achievement. Despite being somewhat poorer, smaller Montana districts performed better than larger Montana districts. Implications and recommendations for state policy are discussed. Contains 33 references and 7 tables. (SV)

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Size as an Issue of Adequacy and Equity in Rural Places: Preliminary Results from the Matthew Project

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Paper presented at the conference, *Education Funding: Adequacy and Equity in the Next Millennium*, Nashville, Tennessee, April 26, 1999.

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This paper reports preliminary findings. While the findings it reports are not expected to change, the interpretations given here are indeed subject to change. Support for the Matthew Project is provided by the Annenberg Rural Challenge Policy Program. The Project is hosted by Ohio University, College of Education, and is housed in the Educational Studies Department.

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Size as an Issue of Adequacy and Equity in Rural Places

This paper reports preliminary results from the Matthew Project, sponsored by the Policy Program of the Annenberg Rural Challenge. The Project extends earlier studies that bear on adequacy and equity (with achievement the dependent variable) to four additional states (Georgia, Ohio, Montana, Texas) and the nation as a whole. This paper discusses the relevant literature, reviews preliminary results from Ohio and Montana, and considers policy implications. The focus of this line of research is on the interaction of SES and district and school size as a structural condition hypothetically regulating student achievement.

Poverty figures as the chief and most prevalent threat to normal academic accomplishment among individuals. If your family is poor, your own odds of succeeding in school lengthen. Your odds are longer still if you attend school with children from many other poor families, which is a likelihood in the U.S., since schools are segregated by social class[1]. In any case, it is certain that affluent communities enjoy decent schools and high-minded pedagogy, whereas impoverished communities continue to "enjoy" shabby schools and a pedagogy of expedience (that is, focus on "basic skills"). In fact, one might say that as the threats increase among increasingly impoverished communities, the local resources to counter them diminish *simultaneously*. It seems an especially vicious arrangement.

If, however, some quite ordinary and easily appreciated feature of schooling could be deployed so as to resolve this dilemma more favorably for the children of society's least powerful members, we should applaud it and move to deploy it as seemed advisable. The Matthew Project

[1]San Francisco recently adopted a plan to integrate its schools on a socioeconomic instead of a racial basis. "Ironically, the fact that economic segregation was never found unconstitutional means that voluntary measures addressed to class are constitutionally permissible" (Kahlenberg, 1999, p. 52-30).

[2] continues a line of work that promises just such news with respect to district and school size. The results of the Matthew Project may offer some guidance on the application of funding that is adequate and equitable but still *not beyond the means of taxpayers* remaining inadequately and inequitably taxed. The Project examines the "educational bottom line" of student achievement, because that is the realm to which fiscal adequacy and equity must be transmitted.[3] Findings bear on improving student achievement in impoverished rural and urban communities (an adequacy pay-off) and on breaking the general bond between SES and achievement (an equity pay-off).

This hope--the search for ways to subvert the evil educational corollaries of poverty--comprises the motive for several studies that investigate the hypothesis that size (of districts and schools) regulated the relationship between SES and performance (aggregate district and school achievement). Though the focal concern is small rural schools and districts, data includes all a state's schools and districts, and has implications for urban and suburban, as well as rural locales. This first preliminary report focuses on the influence of *district size*. Results for schools are similar, and will be referenced.

This paper features district analyses for two reasons. First, districts are the usual focus of state-level efforts to redress questions of inadequacy and inequity. Second, if the benefits of smaller district size can be confirmed, school reformers and restructurers ought to proceed beyond the issues of *class* and *school* size to those concerning *district* size. Considering the recent push for "systemic reform" the absence of much discussion about district size is

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[2]The Matthew Principle" is the title of the article reporting a study that the current work extends; that previous article is available at <http://olam.ed.asu.edu/epaa/v3n18.html>.

[3]Though fiscal adequacy and equity in themselves reflect a commitment to fairness, the translation to school outcomes is not straightforward.

remarkable. The oversight could reflect an urban (or, more properly, a "cosmopolitan"[4]) focus of reform efforts, or it could reflect the view that making districts smaller is as merely unthinkable. If unthinkable, however, it is not undoable, as the case of Montana (reported here) will suggest.

Rural Sacrifice for Adequacy and Equity in an Urbanized System of Schooling

Smaller *school size* currently attracts favorable mention in national reform efforts (e.g., Lee & Smith, 1996; Newmann & Wehlage, 1995). Many educators now appear to concur with the assertion that "small(er) schools are good schools." This emerging nostrum, however, ought to be treated with the same suspicion as the nostrum it has seemingly displaced: "big(ger) is better." Previous work suggests that the notion of optimum size constitutes a misconception. David and Jonathan Sher believe that the right answer to the questions, "What size is best?" (cf. Lee and Smith, 1996) is: "It depends." One thing on which it might depend is the socioeconomic status of the community served (e.g., Haller & Monk, 1988; Howley, 1995, 1996; Sher, 1986).

The support of actual small schools, however, remains elusive because the popularity of the new nostrum centers on its relevance to implementing schools-within-schools or house plans in situations where the huge size of some city high schools (Raywid, 1997) contributes so vividly to the national tradition of targeting the poor for an especially miserable miseducation.

Though some believe that the benefits of small school size can be accomplished through

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[4]By "urban" is meant the metropolitan, cosmopolitan, or universalist perspective that identifies practices imagined erroneously to apply equally well everywhere. On this view, a cosmopolitan ("urban") program would be as harmful to impoverished city neighborhoods as to impoverished rural places. Raymond Williams (1973) traces the logic of cosmopolitan imposition in his classic study, *The Country and the City*.

easy administrative arrangements, a misstep against which both Raywid and Meier (1995) caution, the recommendation to realize similar benefits is seldom extended to districts. Many larger districts, of course, do establish zones or sub-districts for administrative convenience[5]. Such provisions would be as unlikely to improve student achievement as most "school-within-school" schemes. Actually dismantling or *deconsolidating*, large urban districts is practically unthinkable because they are often so large that their budgets far outstrip the budgets of the SEA. This endows their very existence with such economic, political, and bureaucratic power (e.g., Bidwell & Kasarda, 1975; Friedkin & Necochea, 1988) that no one who controls it would willingly relinquish. Large urban districts wield effective power with state education agendas and command disproportionate resources that have a force that is arguably separate from an ethos of service to children, families, or communities.[6]

In contrast to the urban situation, however, the *rural* implications of school and district size for school reform are not much appreciated in universities, state houses, or, to be frank, in many rural LEA offices. Most of the nation, it would seem, assumes, with little curiosity about the matter, that the rural educational circumstance simply *must* be idyllic in comparison to conditions in inner city schools (e.g., Herzog & Pittman, 1995).[7]

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[5]One can well imagine that The City would wish to disown some neighborhoods altogether; indeed, it is accused by some (e.g., Kozol, 1991) of doing just that with respect to fire, police, and social services. Sometimes, as Meier (1995) reports, experimental "educational autonomous regions" are established in big cities. Even in Meier's New York, however, the experiments persist on an insecure footing, despite high praise in the "newspaper of record."

[6]Larger probably does not mean more efficient or more effective (Walberg & Fowler, 1987). The largest districts arguably enjoy the most extreme *dis*economies of scale.

[7]For the most part, the public has never realized that almost all the equity suits of the past several decades were instigated by consortia of rural districts, often working with and organizing the support of many other districts statewide.

In the context of urban concern, the interests of impoverished rural communities in preserving small-scale institutions are apt to be represented as selfish. Rural schools are, after all, already about *half the size* of urban schools on average, and rural districts are already *very much smaller* than unified big-city districts.

And, in general, on a per-pupil basis, small *rural* schools and districts are almost always more expensive to operate than large *rural* schools and districts. Economies of scale (bulk purchasing) seem to exist in the middle range of district and school size (e.g., Fox, 1980). Surely, rural schools and districts, from this vantage, don't need to be any smaller!

In fact, on this logic, small rural schools and districts may need to be sacrificed for the greater good of the entire state system. Although stealing from the rich ("the Robin Hood plan") is politically difficult, stealing from the rural poor [8] is viable and has a long tradition in American education.[9]

In general, state policy makers and school district administrators appear to believe that (1) larger rural schools and districts *help to advance school reform* or (2) rural school closures and district mergers are *tolerable ways to save or reallocate scarce resources* at the state level (e.g., Seal & Harmon, 1995). The combination of these two views has been bad news for

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[8]This sort of "theft" is perhaps a reflection of the relationship between peripheral areas and the cosmopolitan (urbanized) core of the political economy. Rural communities supply cheap labor, cheap materials, and lovely retirement venues. The argument is complicated, but well presented by Wendell Berry (*Home Economics*, 1984) and Raymond Williams (*The Country and the City*, 1973). See also Howley (1991) for a review of literature about the political economy as it pertains to rural schooling.

[9]Katz, writing about the establishment of high schools, noted long ago that local elites pushed for and benefitted from publicly funded high schools. More recently, enforcing an austerity program on rural schools has been presented as a necessity for the survival of state school systems. School closures in West Virginia, for instance, combined with changes in the funding formula, enabled that state to raise teacher salaries by eliminating some 3,000 education jobs (DeYoung & Howley, 1992). State officials, business leaders, and the leading state newspaper all asserted the need to close small (largely rural) schools to keep the state solvent (e.g., Blackford, 1995; Marsh, 1992; West Virginia Roundtable, 1987).

impoverished rural districts during the entire twentieth century. These districts, after all, are the ones most likely to be viewed as culturally deficient (in need of especially intense reform) and unthrifty (since poverty requires a degree of thrift quite unknown among the affluent). Unlike small but affluent suburban or rural districts, they lack the resources to foil state reorganization efforts (DeYoung, 1999). Impoverished rural districts, in short, offer SEAs and legislatures the best opportunities for closure and consolidation.

Why should SEAs, following a century in which the number of school districts has been reduced by 90 percent, wish to eliminate still more districts? Fewer units produce arguably fewer challenges to the administration of "systemic reform." Rural district reorganization, as well, inevitably precipitates school closures (e.g., Peshkin, 1978), as an extension of the general logic. The putative need to consolidate is further buttressed in actual practice by propaganda claiming absolute cost savings (not just the advantage of reallocating funds to other purposes), curricular and technological improvement, and, of course, the psychological advantage of replacing old buildings with new.

Relevant Literature

The work of the Matthew brings this traditional and resistant logic of rural sacrifice sharply into question. Our continuing work is based on a line of reasoning that views the effects of size on student achievement as partly or largely *indirect* and *contradictory* (see the concluding section of this paper for a discussion of "contradictions"). It contrasts with other investigations that have sought to establish small schools as at least equal in outcomes to large schools (e.g., Walberg & Fowler, 1987) or to characterize size as a footnote among features of general school

effectiveness (e.g., Boyer, 1983; Goodlad, 1984; Husén, 1985). The Matthew Project has a brief ancestry in previous studies[10] that included size as an independent variable in achievement studies. We turn next to a brief review of that lineage.

Baird (1969), studying the college participation and achievement of students from small schools, reported an interaction that was interesting because it seemed inconsistent with his other findings, which tended to confirm the overall equality of small and large schools. The relevant analysis examined the joint influence of *setting* (locale) and *school size* on ACT college-entry scores. The results indicated a *positive* interaction (i.e., as opposed to the expected null result) between size and setting: larger school size benefitted students in urban and suburban areas *but not in rural areas or small towns* (Baird, 1969, p. 255). Socioeconomic status was a likely covariant of "setting," so hindsight demonstrates its relevance to the present line of inquiry.

Bidwell & Kasarda (1975) took the view that educational inputs (including district size) influenced achievement *indirectly*. The researchers wrote, "Our working hypothesis is that the environmental conditions that confront a school district will affect levels of student achievement primarily though their effects on the structure and staff composition of these districts" (p. 57). In other words, the effects of SES might be mediated by size (or vice-versa), as a structural condition of a district.

Friedkin & Necochea (1988) formalized the theory in somewhat greater detail than their predecessors. They suggested that community socioeconomic status becomes the "environmental

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[10]In addition, though not considered in the account of the ancestry that follows, we note the similarity of our project with a now-abandoned evaluation model, aptitude treatment interaction, or ATI (Cronbach & Snow, 1977). We share a basic insight with Cronbach and Snow: the effects of an educational treatment might be expected to vary with circumstance.

condition" that indirectly regulates the influence of size on achievement through "constraints" and "facilitators" of "goal attainment." Their study (using data on California schools *and* districts) found that smaller size tended to benefit students in impoverished communities, but larger size tended to benefit students in affluent communities. In addition, they pioneered a calculus application to interpret regression results as effect sizes across varying SES levels.

Huang and Howley (1993) studied the achievement of the universe of Alaska students at three grade levels. The study selected only students who had been in continuous attendance at the same school for four years, and, while including an interaction term (SES * size), it introduced blocks of control variables for school resources, school climate, and student academic background. The study clearly showed that SES exerted the weakest negative influence on achievement in small schools and the greatest negative influence in large schools, all else equal. In addition, and somewhat surprisingly given the large number of control variables, the interaction term remained significant in the regression equations.

Howley (1995, 1996), interested in the extent to which such results might pertain in a rural state with a very different economy, history, and political legacy, replicated the Friedkin and Necochea analytical method to study the relationship between school and district size and achievement in West Virginia. The results were similar. Howley also provided a correlational analysis of the relationship of SES and achievement within two groups of schools divided by school size (one-half standard deviation below plus one-half standard deviation above the median on size). Results showed dramatically weaker relationships among the groups of smaller as compared to larger schools. In other words, both excellence (for children in impoverished communities) and equity (overall) were improved with small schools (i.e., many of which West

Virginia subsequently closed).

Present Study

On reading the results of the West Virginia study, staff of the Rural Challenge Policy Program asked that the investigations of the previous study be extended. Agreement was reached to replicate the key analyses in four strategically chosen states--Georgia, Ohio, Montana, and Texas.[11] In addition, the Matthew Project will be conducting a national study using the NELS data base (i.e., with students the unit of analysis). Of principal interest to that study will be the relationship between SES and achievement in small as compared to large schools. This paper, however, summarizes preliminary results only for Ohio and Montana.

Methods

The studies underway repeat the earlier statistical methodology, which is explained in detail in the online article referenced on page 1. In short, however, the method constructs regression equations of the form $z = ax + by + cxy$, where z is a relevant dependent (achievement) variable, x is the measure of size, y is the SES measure, and xy the interaction term. The hypothesis of an interaction effect is accepted if c (the regression coefficient of the interaction term) remains significant in the equation with all three independent variables entered. It is a simple but theoretically grounded model.[12]

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[11]Chosen to represent rural and urban locales, to include substantial minority populations, to represent different regions of the country, to include equity-suit states, and to include different de facto policies toward consolidation (Montana has explicitly rejected consolidation and maintains many small schools and small districts).

[12]Additional variables introduced as controls (e.g., racial composition, locale, teacher FTE) do not appreciably change the results and are not included directly in results reported here.

Effect sizes are estimated for various SES levels by taking the partial derivative of the function (differentiating achievement [z] with respect to size [x] while holding SES [y] constant). Like all derivatives, the partial derivative represents a rate of change--in this case the rate of achievement change per change in size; when the partial derivative is multiplied by the ratio of the standard deviations of size and achievement, the result yields a mathematical expression for effect size in standard deviation units, which expression can then be evaluated at different levels of SES to produce a picture of the *regression-based differential effect of size at varying levels of SES*. Again, full and clear details are available in the online report of the results of the previous study.[13]

To gauge the effects of small and large size (of districts and schools) on the relationship between SES and achievement, we divide our cases (schools or districts within states) into two groups at the median on size and compute the relevant zero-order correlations. Restricted range is not a great problem, but to the extent it is a problem with these data, it tends to produce underestimates of the relationship more commonly among the group of larger, and not the group of smaller, districts and schools.

Variables

Variables included achievement measures (the dependent variables), a variety of proxies

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[13]The Matthew Project reiteration made a useful improvement over the previous study. In the West Virginia study, collinearity between the interaction term and the other two independent variables had been a problem (see Howley, 1996 for a discussion). In the interim, we have adopted Cronbach's method for eliminating such collinearity, which involves centering the additive independent variables (size and SES) on the mean of each, respectively, and multiplying the individual values of the centered transformed variables to produce the interaction term (Cronbach, 1987). This procedure eliminates collinearity in almost all equations by substantially reducing the zero-order correlations between the simple additive variables and the multiplicative interaction variable.

for SES, and measures of school and district size. Additional variables included those to identify typical grade-span configurations in each state (e.g., K-6, 7-8, 9-12) and percent black (Ohio) or Indian (Montana). These variables were used in regression analyses principally to identify subgroups of schools and districts. For the Ohio analyses, teacher full-time equivalency (FTE), a control for class size, was used in order to test the surmise that evident school- or district-size effects (direct and interactive) might be an artifact of the smaller class sizes typical of smaller schools.

Dependent variables were grade-level measures of achievement from statewide testing data sets for the 1996-1997 academic year as supplied by the Ohio and Montana[14] SEAs. Ohio uses state-specific proficiency tests and posts its school- and district-level results on the SEA website; scores are reported as percentage of students passing the criterion established for these tests[15]. Montana uses familiar norm-referenced tests[16]; and reports scores as NCE units (mean of 50 and standard deviation of about 21). Ohio administers its tests in grades 4, 6, 9, and 12; Montana administers its tests in grades 4, 8, and 11. In both states, we used averages of multiple test scores (always including reading and math, but also always two or three other main domains depending on state circumstance). Each of the resulting variables was normally distributed and, of course, each constituted a broad-based measure of aggregate student achievement in schools

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[14]The Project is especially indebted to Dr. Dori Nielson of the Montana Office of Public Instruction for supplying data files that included achievement scores for the smallest schools and for other advice as the analyses proceeded.

[15]Ohio reports both "regular" and "advanced" pass rates; analyses used both sets of scores, though this report considers only the former. Overall, however, results were similar but more attenuated in the case of advanced pass rates.

[16]Approximately 90 percent of cases report ITBS, CTBS, or Stanford scores. Analyses performed by test type did not yield results very different from those using the NCE scores of all test types.

and districts.

Good, current measures of SES are difficult to locate for school- and district-level analysis. Variables used here differ somewhat between the states and between the two units of analysis (school and district). A variety of district-level and school-level proxies for SES were available, each with its own weaknesses. The criterion for use was magnitude of relationship between the available measure and our measures of student achievement. For the Ohio data set, this was the district-level rate of Aid to Dependent Children (ADC); in Montana, the free-and-reduced price meal rate exhibited the strongest correlation, though percent of Indian students also showed a strong correlation with the dependent measures. Analyses with that alternative variable yielded very similar results; only the results with the first-cited measure, however, are reported here.

When necessary, size was measured as the average number of students enrolled in a grade within a district. This construct separates the confounding influence of grade-span configuration (i.e., a K-8 district of 400 students is actually larger than a K-12 district of 400 students). This distinction was necessary in Montana but not in Ohio, where all districts are of the K-12 configuration. Therefore, size in Montana, in the analyses that follow is the relevant grade-cohort size, whereas in Ohio it is total district enrollment.

Results

For each state, this section will summarize and contrast preliminary findings in Ohio and Montana and present comparable analyses representative of the findings. These analyses include (1) descriptive statistics for relevant variables, (2) district- and school-level regression equations

for the 9th (Ohio) and 8th (Montana) grades, (3) effect sizes as appropriate (i.e., Ohio only), and (4) correlational analysis by district size halves (state universe divided at the median on the size variable).

Ohio. The hypothesis of this series of studies is that a condition exists (smaller schools) that would help reduce the negative effect of poverty on student achievement. Ohio students must pass the 9th grade proficiency test in order to graduate from high school. For students it is a high stakes test. This high-stakes requirement makes examination of results for this level urgent and particularly salient. Impoverished students, of course, are those most likely to encounter difficulty passing this test. Table 1 presents relevant descriptive statistics for the variables of interest for the N=605 districts included in the analysis.[17]

[17]Ohio maintains 612 regular K-12 school districts; island districts in Lake Erie were not included in the analysis, and missing data eliminated a few others.

Table 1

Descriptive Statistics (Ohio Districts; N=605)

Variable	mean	MDN	SD	min	max
size (ADM)	2892	1786	5140	347	73061
ctrlnadm	-.0056	-.0823	.7749	-1.72	3.63
SES (ADC)	9.988	7.040	9.436	0	66.20
ctrlnadc	-.0006	-.0741	.9951	-2.59	2.32
size * SES	.1388	-.0184	1.0068	-3.79	8.40
P9AV4SCO	81.82	82.75	8.9152	36.25	100.00

size (ADM) = average daily membership of district
ctrlnadm = logged and centered ADM (size variable)

SES = district aid to dependent children rate
ctrlnadc = logged and centered ADC rate (size variable)

size * SES = ctrlnadm * ctrlnadc (interaction term)

P9AV4SCO = 9th grade achievement
(average percent in district passing math, reading, writing, citizenship)

As Table 1 implies, skewness in the independent variables (SES and ADM) indicated the need for transformations; both variables were transformed as the natural logs of the original variables and then centered according to Cronbach's (1987) procedure. Table 1 shows the great range in school district size in Ohio; the median size of 1786, in fact, shows that a majority of Ohio districts enroll fewer than 2,000 students.

Table 2 reports the results of regressing the measure of achievement (average percentage of students in a district passing the four required 9th grade proficiency tests) on the model's independent variables (size, SES, and the interaction of size and SES). When entered in the

regression equation, all variables proved highly significant ($p<.0005$) and all showed a negative relationship to achievement. The model exhibits an adjusted R-square of .565, thus accounting for more than half the variance in aggregate district-level 9th-grade achievement. Including teacher FTE (a control for class size) did not alter the results.

Table 2

Summary of Hierarchical Regression Analysis: Ohio Districts, 9th Grade

Variables in the Equation	B	SE B	β
size (ctrlnadm)	-1.572	.318	-.137
SES term (ctrlnadc)	-5.986	.245	-.668
interaction term	-1.812	.241	-.205

adjusted R^2 = .565

Notes.

(1) N=605 (607 cases had complete data; two cases with standardized residuals > 5.0 removed as outliers)

(2) All regression coefficients significant at p <.0005; equation significant at p <.0005.

In order to suggest the magnitude of the differential effect thus confirmed by regression analysis, effect sizes at different SES levels were computed following the procedure outlined previously (i.e., differentiating the Table 2 equation while holding SES constant, standardizing the resultant derivative, and evaluating it at different levels of SES). Table 3 reports these values, anchored with corresponding values of the untransformed, uncentered variable for ease of

interpretation. In order to suggest the pattern of results at other grade levels, Table 3 also reports the effects sizes (calculated similarly from the relevant, but unreported, regression equations) for grades 4 and 6[18].

Table 3

Effects of District Size on Achievement at Varying ADC Rates

ADC Rate	Effect Size grade 9	Effect Size grade 6	Effect Size grade 4
3%	+.27	+.38	+.98
15%	-.27	-.01	+.49
25%	-.35	-.11	+.37
50%	-.46	-.15	+.32
65%	-.50	-.18	+.28

Two related observations are worthy of note with respect to Table 3. The first observation is the overall interaction pattern; lower poverty rates are associated with higher benefits of size. That is, the benefits of larger size accrue most strongly when poverty is nil. Second, as grade level increases, the benefits of size accrue to an increasingly narrow band of affluence, and the cost of size accrues to an increasingly broad band of poverty. The unreported regression equations for grades 4 and 6 include a *positive* (direct or additive) coefficient of size[19].

[18]The interaction effect was not significant (regular pass rate) at grade 12 in the district-level analyses. The dropout effect following grade 9 is a hypothetically confounding influence; dropout rates are quite high in some districts; this is especially true of large urban schools, which exist in Ohio as in some (but not all) other states.

[19]Beta weights show it, however, to be comparatively weak within the respective equations.

Only in the grade 9 equation is the coefficient of size negative and, as the beta value given in Table 2 would indicate, comparatively stronger within the equation. The finding is consistent with previous work in West Virginia, where a pattern of increasingly negative effects of size as grade level increases was evident (cf. Howley, 1995, 1996).

The final analysis to be reported for Ohio (see Table 4) displays the within-group correlations between district size and aggregate 9th-grade achievement when districts are divided into two groups (larger and smaller districts) at the median ADM (i.e., 1786).

Table 4

Ninth Grade Achievement, Socioeconomic Status, and District Size in Two Groups of Ohio Districts (N=605)

	means and correlations				
Size	achievement mean[a]	ADC mean[a]	grade 9 enrollment[a]	$r_{y,z}$	$r^2_{y,z}$
larger[b] districts	80.23 (10.27)	11.17 (10.53)	4674	-.76***	.573
smaller[c] districts	82.27 (11.47)	8.81 (8.01)	1122	-.42***	.178

Notes. $R^2_{y,z}$ is the variance in y (SES) associated with z (achievement). $R_{y,z}$ is the correlation.

*** => p < .001 (one-tailed)

[a] Standard deviations for values of the variables given in parentheses.
[b] n = 303
[c] n = 304

Table 4 is consistent with the findings of previous studies (Howley, 1995, 1996; Huang & Howley, 1993). Smaller Ohio districts exhibit a weaker correlation between district-level SES

and aggregate student achievement at the 9th grade level. The pattern is the same for grade levels not reported here. On average, at the 9th grade level, smaller districts (the smaller half of districts in Ohio) exhibit a relationship between SES and achievement that is weakened by about 60% in comparison to the relationship exhibited in the larger half of districts.[20]

Though not reported in this paper, school-level data revealed substantially the same patterns as reported here for ninth-grade scores (total variance accounted for y the model was 43% in 9th-grade school-level regressions, as compared to the district-level value of 57%). Finally, with the correlational analyses for groups of schools divided at the median on size, several SES variables demonstrate the stability of the pattern of results reported, despite the weaker over correlation of these variables to the achievement variables.

Montana. Table 5 reports the descriptive statistics for Montana that parallel those given for Ohio in Table 1. There were 248 districts with valid scores and size data for 8th grade students; 38 of these had missing data on the SES variable, yielding a total N = 210 for analysis.

[20]Across all four grade levels in Ohio districts, r-squares for the group of smaller districts average about 20% as compared to 50% for the group of larger districts (regular pass rates).

Table 5

Descriptive Statistics (Montana Districts with Grade 8 Students; N=210)

Variable	mean	MDN	SD	min	max
size (8th)	61.16	24.50	131.57	1	1186
ctr_lns8	-.3393	.2509	1.1950	-3.24	4.13
SES (frl)	38.42	33.01	21.28	0	100.00
ctr_sqaf	.2208	.0104	1.7233	-5.73	4.27
size * SES	-.3838	-.0328	2.1026	-13.80	7.04
DMEAN_8	57.37	58.04	8.3938	24.08	74.96

size (8th) = 8th grade cohort membership within district
ctr_lns8 = logged and centered 8th grade cohort membership (size variable)

SES (FRP) = district free-and-reduced-price meals rate
ctr_sqaf = square-rooted and centered FRP rate (SES variable)

size * SES = ctr_lns8 * ctr_sqaf (interaction term)

DMEAN_8 = 8th grade achievement (weighted average NCE district score for reading, language arts, math, science, social studies)

Table 6 provides the statistics for the 8th grade regression equation, with square-rooted and centered free-and-reduced-price meals rate the SES measure.[21] The interaction term is not significant (p=.058), the direct effect of size is negative, and, of course, the SES variable (as in the equations in all analyses irrespective of state, unit of analysis, or grade level) is significant.

[21]Regressions were also run, with substantially the same results, using the percent of Indian students enrolled in the districts as the SES measure (logged and centered).

Table 6

Summary of Hierarchical Regression Analysis: Montana Districts, 8th Grade

Variables in the Equation	B	SE B	β	p
size (ctr_lns8)	-1.032	.450	-.147	.023
SES term (ctr_sqaf)	-2.531	.299	-.520	.000
interaction term	-0.480	.252	-.120	.058

adjusted R^2 = .266

The most important finding to note in Table 6 is the comparatively small amount of variance explained by the model (27%). The magnitude of this statistic is approximately half that explained by the Ohio analyses. This pattern is, in fact, found throughout the Montana analyses, irrespective of unit of analysis (district or school), grade level, or SES proxy used: In Montana the evidence of an interaction effect is weak (significant in most equations only at grade 4) and the overall variance explained by the model always comparatively low. Hence, there are no interaction effects to report. The *direct* effect of size (district or school) is negative in all of these equations, and is generally statistically significant.

Table 7

Eighth Grade Achievement, Socioeconomic Status, and District Size in Two Groups of Montana Districts (N=210)

	means and correlations				
Size	achievement mean[a]	FRP mean[a]	grade 8 enrollment[a]	$r_{y,z}$	$r^2_{y,z}$
larger[b] districts	56.36 (7.27)	35.50 (18.82)	110.49	-.643**	.413
smaller[c] districts	58.36 (9.30)	41.29 (23.18)	12.76	-.390**	.152

Notes.

These N=210 districts are those appearing in the regression analysis reported in Table 6.

$R^2_{y,z}$ is the variance in y (SES) associated with z (achievement). $R_{y,z}$ is the correlation.

** ==> p < .01 (one-tailed tests)

[a]Standard deviations for values of the variables given in parentheses.

[b] n = 106
[c] n = 104

Table 7 provides the results of correlational analysis of the relationship of achievement and SES in these N=210 districts. Three points are remarkable about the results given in Table 7. First, *larger* districts exhibit a somewhat *lower* average achievement than the smaller schools, about one-fifth of a standard deviation lower (the standard deviation for all 210 districts is 9.64). Second, the larger districts exhibit a *higher* SES (i.e., lower rate of free-and-reduced-price meals) than the smaller districts (approximately one-fourth of a standard deviation higher). Third, the influence of restricted range (smaller standard deviations) pertains to the group of *larger* districts, suggesting that the explained variance and associated correlation statistic may be

underestimates. In other words, the somewhat poorer, smaller Montana districts seem (a) not only to have performed somewhat better than the somewhat more affluent larger Montana districts but (b) to have done so with greater equity. This complex result would by no means have been predicted.

Conclusions

Four conclusions seem warranted by the evidence. First, and quite improbably, the smaller Montana districts (which are somewhat poorer than the larger Montana districts) seem to have performed somewhat better than the larger Montana districts (which are somewhat more affluent than the smaller Montana districts). This result would not be expected even in consideration of the hypothetical benefits of small size, because small size would *not* be predicted to *overcome* and even *reverse* the negative influence of poverty such that a group of poorer schools would outperform a group of more affluent ones. More surprising still, since equity has sometimes been construed as incompatible with excellence, this improbable result seems to have been achieved while conditions of greater equity arguably prevailed within the smaller as compared to the larger districts.

Second, the "equity effect" of small size (of districts and schools) is evident in *both* Ohio and Montana. Depending on grade level, unit of analysis, and state, this reduction of influence averages about 50% (and varies between about 20% and 80%). Results are remarkably consistent, and accord with findings previously reported for West Virginia (Howley, 1995, 1996).

Third, the hypothesized interaction effect was *confirmed for Ohio* districts and schools but *not confirmed for Montana* districts and schools. This preliminary report presents regression

results for an important level (8th and 9th grades) to characterize this general result.[22] Children from affluent communities can benefit from larger schools, according to the Ohio data, but not children from impoverished communities. A reasonable inference is that Ohio should maintain smaller schools in urban areas serving impoverished African Americans.

Fourth, the proportion of variance accounted for by the model is *substantially less in Montana* as compared to Ohio (generally less than half). Due to differences in measures that were only approximately comparable, this conclusion is probably the weakest of the four. This more tenuous conclusion, though, is logically implicated by the other findings. At the very least, it could serve as a defensible, directional hypothesis for a study with better comparability of data.

Implications 1: The Issue of Size as a State-Specific Policy Context

The norms of size (for districts as well as schools) vary dramatically from state to state, as suggested by the data in Tables 1 and 5. However, the size data presented, however, are not directly comparable because (as explained previously) the metric of district size differs.

However, since K-8 districts are by far the most common configuration among elementary districts in Montana, approximate comparisons of district size in Ohio and Montana can be estimated by multiplying the values of the "SIZE8" variable (Table 5) by 9[23]. This exercise would suggest that the median (or mean) Ohio district serving students of comparable

[22]A summary of school and district statistical analyses is available from the author.

[23]This procedure assumes that the grade 8 cohort size can substitute as the average grade-cohort size across all grades in the school. The number of grade cohorts in a K-8 school is, of course, 9. The resulting statistics are probably reasonable approximations of statewide averages.

age is about 5 to 8 times the size of the comparable Montana district.[24] On average, 8th grade students in Montana attend much smaller districts than 9th grade students in Ohio. Though data are not reported in this paper, Montana students also attend much smaller schools than Ohio students do.

This observation constitutes an historically inconvenient fact, at least in view of the historical argument that states must consolidate (cf. DeYoung & Howley, 1992; Howley, 1995, 1996) districts and close smaller schools in order to fashion an efficient and effective system of public schooling. Does Montana spend a great deal more per pupil, an admittedly gross measure of fiscal adequacy, than other states? On the basis of the historical argument, it would seem that it must.

Nonetheless, the inconvenient facts about finance compound the inconvenience of facts about the size of Montana's districts. According to profiles in the SDDB (NCES, 1995), Montana expended (in 1989) $3,995.28 per pupil in current expenditures; Ohio, by contrast expended $4,117.49. In other words, despite the transportation costs associated with its more substantial

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[24]225 versus 1786 for the median; 540 vs 2892 for the mean, cf. Tables 1 and 5.

rural population--26% in Ohio, versus 47% in Montana-- and despite the much smaller size of districts and of schools, the two states expended similar current expenditure funds per pupil. Taking in view the conclusions of the preceding section of this paper, then, an objective observer might well conclude that, in violating the accumulated professional wisdom of the 20th century, Montana has acted brilliantly and is now reaping the benefits--good results at only modest expense.[25]

Is there any basis for this conclusion? There is some basis. Montana *typically* and *routinely* posts quite high scores on the exams of the National Assessment of Educational Progress. Ohio has not participated in the NAEP state trials, so any actual comparison with Ohio is moot. But comparisons with the other states in the NAEP group are not moot, and Montana is consistently near the top. But perhaps the reason is socioeconomic; perhaps Montana is among the more affluent states, so its good performance on the NAEP would be *expected*. To the contrary, however, Montana's median household income was 23.5% lower than the national median household income, and the percentage of its population in poverty was 18.6% higher than the national average (again according to SDDB data) . Conservatively, one might suggest that, on the basis of this logic, that with a somewhat worse profile on major SES measures, Montana routinely performs better on national tests than average at no greater than average expense. This observation is, at the national level, rather like the performance, within Montana itself, of the group of smaller versus the group of larger districts.

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[25]An alternative reading of course, would fix Montana's "brilliance" in its continuing rural nature--an ontological, not an ethical, source. However, it is also true that politicians and bureaucrats in the other, equally rural, "mountain state" (West Virgina) have to this day followed the opposite course (cf. DeYoung & Howley, 1992).

One can go further and also note in more detail the SES differences between Montana and Ohio districts. The average Montana district has about 10% Indian students, a median family income of about $27,200, and 23% of its children living in poverty. The average Ohio district has about 2% Black students, a median family income of about $36,400, and 14% of its children in poverty (data from the Matthew Project data sets). Solely on the basis of statewide SES characteristics, then, one would be tempted to hypothesize, conservatively, that, if Ohio *were* to take part in the NAEP testing, it would perform on a par with Montana. If any speculation at all is unfair, though, even this conservative speculation could be unfair.

It is, however, fair to note that Montana's Indian minority attends schools and districts that are as small as those attended by other Montana students, whereas Ohio's African-American students on average attend schools and (city) districts that are much larger than those attended by other students.[26] Given the findings of this study and findings from the previously reported West Virginia study, then, it would seem reasonable to hypothesize that this difference in size of units attended would produce an overall achievement benefit for Montana's Indian students and an overall achievement deficit for Ohio's Black students (on the insight that poverty and minority status substantially co-vary). Experimental tests of this hypothesis, are, of course, unlikely, so the Matthew findings must be accepted as a close approach.

Montana is a rural state that has, unlike other states (cf. Howley, 1995, 1996) decidedly *chosen* to retain its small schools. Evident support exists at the state as well as the local level for this choice (Schwinden & Brannon, 1993). The choice is financially supportable, as well. The

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[26]Data not reported here, but available from the author, and easily analyzed from publicly available data sets (e.g., Common Core of Data information at the NCES web site).

results reported here attest to good achievement results, with the overall good outcomes seemingly distributed, overall, in an equitable fashion. Much remains to be learned, however, about this experience at the level of individual students.

Implications 2: Policy Recommendations

A key question for states like California, West Virginia, and, now, Ohio is the source of the interaction effect identified by study results. The evident result could be produced (as in West Virginia) mostly by the presence of many small schools serving impoverished communities, or (as in California) by many large schools serving impoverished communities. It could be a combination of conditions.

Ohio resembles California in that the majority of poor African-American students are served by large urban schools, but many small rural schools serve (largely White) impoverished communities in southeast Ohio, while still others serve communities with varying degrees of affluence. Ohio's strong tradition of local control seems to have produced a diversity of school and district forms. In some cases this diversity will probably have supported equity and adequacy of outcomes, but in other cases it will probably have undermined such outcomes.

Whatever the *interesting details*, however, they cannot generally be of great help to those who fashion policy and to those who are concerned to maximize the intellectual potential of all citizens. In fact, neither researchers nor the public should look to research to *determine* answers to the important and difficult questions, but only to *inform* them. The details may be interesting, but are not critical, at least in this instance, to public policy.

The forest, in this case, is more important than the trees, at least with reforestation in view. The Matthew Project results, however, point to contradiction, so enlightened public debate would be essential.

Citizens and policy makers in the states might consider four questions related to the issue of district and school size. Though not answered very easily, the important questions are stated quite simply:

1. Should states set an absolute upper limit on the sizes of districts and schools? If the answer is "yes," then what should these caps be for elementary, middle, and high schools and for districts?

2. In states where an interaction effect exists, which districts and schools violate these limits? What should be done in these cases?

3. In states where an interaction effect exists, how should such upper limits vary by school and district SES? Should *any* lower limits prevail? What would they be?

4. What policies might successfully promote the re-scaling ("restructuring") of state systems of schooling as needed the better to serve all the communities whose children attend them?

I have, with respect to the first question, suggested and illustrated a logic for establishing such upper limits as they effect *school* (not district) size (Howley, 1997). When these suggested limits were applied to *schools* in Ohio, approximately 30% of high schools, 40% of middle schools, and 50% of elementary schools were shown to exceed the limits derived from this logic.[27] For Montana, the comparable results were 8%, 4%, and 7%.

I cannot, of course, maintain that my suggested limits are the best, the most sensible, or

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[27]The logic derives from the fact that elite private schools enroll about 1,000 students in grades 9-12, taken as the upper limit based on the notion that a school this large is most suitable for the most affluent community. Upper limits for common grade configurations in Ohio based on Howley (1997) are: 9-12 (1,000); 6-8 (600); and K-6 (400). The most common middle-level configuration in Montana is 7-8 rather than 6-8, so 400 students would be the hypothetical upper limit. I have not suggested upper limits for district size, however.

the most logical. This example, however, shows that such considerations can establish benchmarks capable of revealing striking differences that should provoke some debate about states' policies on school and district size, in light of results such as those reported in the paper.

The fourth question, above, is perhaps the key policy question. Because it revolves around the unfamiliar issue of scale, however, it is more complex than it might at first seem.

The concept of scale is most fully described in chaos theory, strictly and not loosely defined (e.g., Gleick, 1987). In chaos theory, the evident "chaos" of appearance (as in weather and climate patterns, population growth, plant growth, hydraulic flows, and so on) is actually ordered by the simple repetition of characteristic structures at different levels of detail. Computers have allowed us to appreciate this previously obscure reality. The now classic general example of this iterative patterning of the structure of chaos is the Mandelbrot set, which repeats itself endlessly the finer the detail at which it is examined. This is the phenomenon of "scale" that I imagine might apply to state systems of schooling.

The scale of operations in Montana, as compared to Ohio, would (hypothetically at any rate) seem more finely adjusted and better balanced: in effect, more intimate. The state system is much smaller as a whole--serving about 1/10 the number of children as compared to Ohio. The districts and schools are smaller, as noted previously, and class sizes are smaller than the national average as well. In fact, Table 5 suggests that many of the very smallest Montana classrooms retain the multi-age grouping of single-teacher schools.[28]

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[28]That is, with one or two students per grade, such (whether elementary or high school or K-12) districts surely do not maintain separate classrooms or teachers for each grade, as the norms of professional practice (age-grade-placement) would otherwise require.

Chaos theory would suggest, however, that what one might refer to as the "more intimate" scale of public schooling in Montana extends to a still more finely grained level *within individual students and teachers*. This possibility is highly speculative, of course, and strange, so please bear with the discussion. The hypothetical reality of "small scaling" within individuals might be understood as a possible matter of *attention* (i.e., to people, to facts, to ideas, to dispositions, and to relationships) characteristic of more "intimate" or "better balanced" or "more finely adjusted" contexts.

Unfortunately, people within such an "intimate" system are no better placed to recognize their circumstances than a tree within a forest.[29] This assertion, which, incidentally is a common one throughout the history of science, would explain why we have not previously noticed the implications of scale effects in systems of schooling.[30]

Though this speculation is risky, I offer it primarily to suggest the ambiguity and complexity of answers that might possibly given to question four. Answers to the first three questions would be simple by comparison to any more or less fully given answer to question four. The fourth has a "revolutionary" teleology, with implications for turning state systems of schooling upside down or inside out, in the very unlikely event the teleology were actually pursued a bit.

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[29]Rural people, do, however, express a sensibility of this sort--which might otherwise be called "sense of place," "connection to the land," or when lost, yearning. The eminent sociologist Christopher Lasch reminds us that the word "nostalgia" emerged from the experience of displaced rural populations in the nineteenth century, who, much like the urban Appalachians of today, keenly suffer the loss of a sense of place.

[30]Though ultimately accessible, reality is seen to lurk well beneath the surface of appearances.

Limitations

In studies of schools and districts, the measures of SES used in analyses usually represent one compromise or another. In this study, the compromise consisted of using the 1996 SES measures supplied by the respective SEAs, after comparing the correlations with achievement of many other available but less proximate measures. None of the SES proxies drawn from the School District Data Book (National Center for Education Statistics, 1995) correlated as highly, perhaps because these variables were at least six years out of date with respect to the SEA-supplied measures.[31]

Despite care in selection, the use of different measures in the two states renders reported comparisons somewhat problematic. Confirmation of the "equity effect" in such diverse states as West Virginia, Montana, and Ohio, however, suggests some warrant for comparability despite these doubts. Confirmation of the "adequacy effect" (interaction effect) in California, Ohio, and West Virginia reinforces the inference.

Another question about the reported "equity effects" concerns restricted range. Each comparison group (i.e., smaller vs. larger schools) shows a somewhat restricted range on one or the other correlated variable, depending on the analysis. Reported values are best viewed as conservative estimates. The stability of the pattern,[32] however, provides a form of concurrent validity for the overall finding. In doubt is the precise magnitude of difference.

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[31]The SDDB aggregated 1990 decennial census measures to the district level, for all US public school districts. Variables included, for instance, percent of children living in poverty, median income of families, median income of families with children, median housing value, percentage of students not speaking English, and so forth.

[32]Lower correlations among the groups of smaller units, across states, units of analysis, and a range of SES proxies.

The meaning of aggregated scores must be understood as indicating a phenomenon that differs from the phenomenon of "student learning." Inferences about the achievement of individual students from this work are not warranted, since the units of analysis in this study were districts and schools. Aggregated achievement scores are better understood as a rough measure of goal attainment for schools or districts (cf. Bidwell & Kasarda, 1975; Friedkin & Necochea, 1988).

The Matthew Project does not address the processes that small size enables and that seemingly benefit marginal students. A substantial related literature, however, suggests probable enabling conditions: student participation, relationships that are more attentive, better communication among staff, and so forth. See Fowler (1992) and Meier (1995) for the best summary of empirical work and the richest insights from a participant-observer to date

Finally, this report does not address the distribution of achievement among individual students within schools. Comparatively good school- or district-level aggregate scores can be had through various combinations of improved achievement among different groups of individuals in the same school or district. Improvement might come at the hands of high- or middle- or low-achieving students principally, or from some combination of these.

For most grade-level tests (as these are), however, the likeliest way that aggregate scores improve is with improved scores among otherwise low-performing students. Test construction is the reason. With grade-level tests, high-performing students will *already* be performing closer to the ceiling of the test than other students. This fact means that improvement among high-scoring students materializes with greater difficulty than among low-scoring students because the

opportunities for such improvement dwindle as scores move toward the test ceiling.[33] Thus, smaller schools probably enable the "bottom half" of the achievement distribution to make a closer approximation to "normal" achievement levels.

Curiously, this observation might, as well, suggest that the observed interaction effect underestimates the beneficial effects of larger size on more affluent students. If such students were administered wide-range (rather than grade-level) achievement tests, they might demonstrate more reliably a level of achievement beyond that which the grade-level test can reliably measure. This possibility will be pursued in future work. One of the Ohio measures is the percentage of students passing that state's tests at an advanced level. The Montana data set also includes results by stanine. Future reports may describe the effect of district and school size on variables reflecting those measures, and may consider the way in which student achievement is distributed within small schools generally (national level analyses with the NELS data set).

Theoretical Perpsective: An Addendum

In theoretical terms, previous studies have taken a functionalist approach, seeking and finding equilibrium in the system of schooling. In the present work, however, the issue of school size is seen as an issue of "contradiction."[34] The school-closure battles of the past century would

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[33]That is, fewer items sample the higher reaches of performance, so that scores become more unreliable, and the error bands around individual scores widen.

[34]"Contradiction" is a structuralist notion particularly apparent in various qualitative views of social organization. Contradictions manifest themselves as logical incompatibilities (e.g., small schools serving poor students best and large schools serving large students best even as all students must attend a single school), but, in a structuralist epistemology, are taken to reflect the dynamics of social structure from which social change arises. Thus, a century of school closures might hypothetically suggest a deployment that has tended to serve the affluent better than it has served the poor. Closures, however, nearly always produce conflict and contention as the less powerful object to their treatment. On this view, one might say that the social contradiction has developed to the

seem to warrant a structuralist perspective. A structural view (i.e., rather than a "structuralist" view) of the issue of size is also consonant with the literature on private enterprise, however. As in much of the work about firms, in the present work, the size of districts and schools is understood as a durable condition (i.e., a structure) and *not* as a container of effective processes that might be extirpated and transplanted elsewhere (e.g., in larger schools) or as necessarily harmful ("small is good") or necessarily beneficial ("bigger is better") condition. The Matthew Project continues to entertain the unusual possibility that smaller schools and larger schools might be beneficial in some circumstances but not in others. As always, when power is brought to bear, the question is who benefits from actions taken by powerful individuals (e.g., politicians) and institutions (e.g., SEAs) and who suffers.

Today, especially, it would seem that state school leaders might anticipate an improved efficiency of reform in a more consolidated state system. Simply communicating with over 500 districts about the minutiae of legislation and new initatives is an understandably daunting chore.[35] In the age of systemic reform, the longing among state officials for fewer and fewer districts must indeed be strong. Of course, educational equity (measured as parity in district-level school funding) is improved when there are fewer districts. States with fewer districts (as in the South) therefore appear to be more equitable (Education Week, 1997). Whether or not

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point that it can actually be gauged with a functionalist research technique (i.e., regression analysis with a salient interaction term). Of course, this (methodological) contradiction is (itself) related to many others in the social structure.

[35]In the rural South, enduring post-Bellum (i.e., Civil War) rural poverty has ensured careful attention to *financial* efficiency, a commitment that one might argue has ensured more prevalent consolidations and closures than has been possible elsewhere. However, in places settled by independent "yeoman" farmers, consolidation has been far less successful. Illinois, Missouri, Ohio, Nebraska, and Pennsylvania all maintain more than 500 LEAs to this day. Montana, incidentally, maintains 457 (comprising about 900 schools).

such equity is an artifact of organizational structure has not been carefully questioned. Such equity, in any case, hardly assures either adequacy or equity of outcomes.

This is the first publicly reported analysis of the Matthew Project. Emerging data analyses will disclose finer-grained results, and results in all four states and the nation, in the nearer future.

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